Status of the Pierre Auger Observatory

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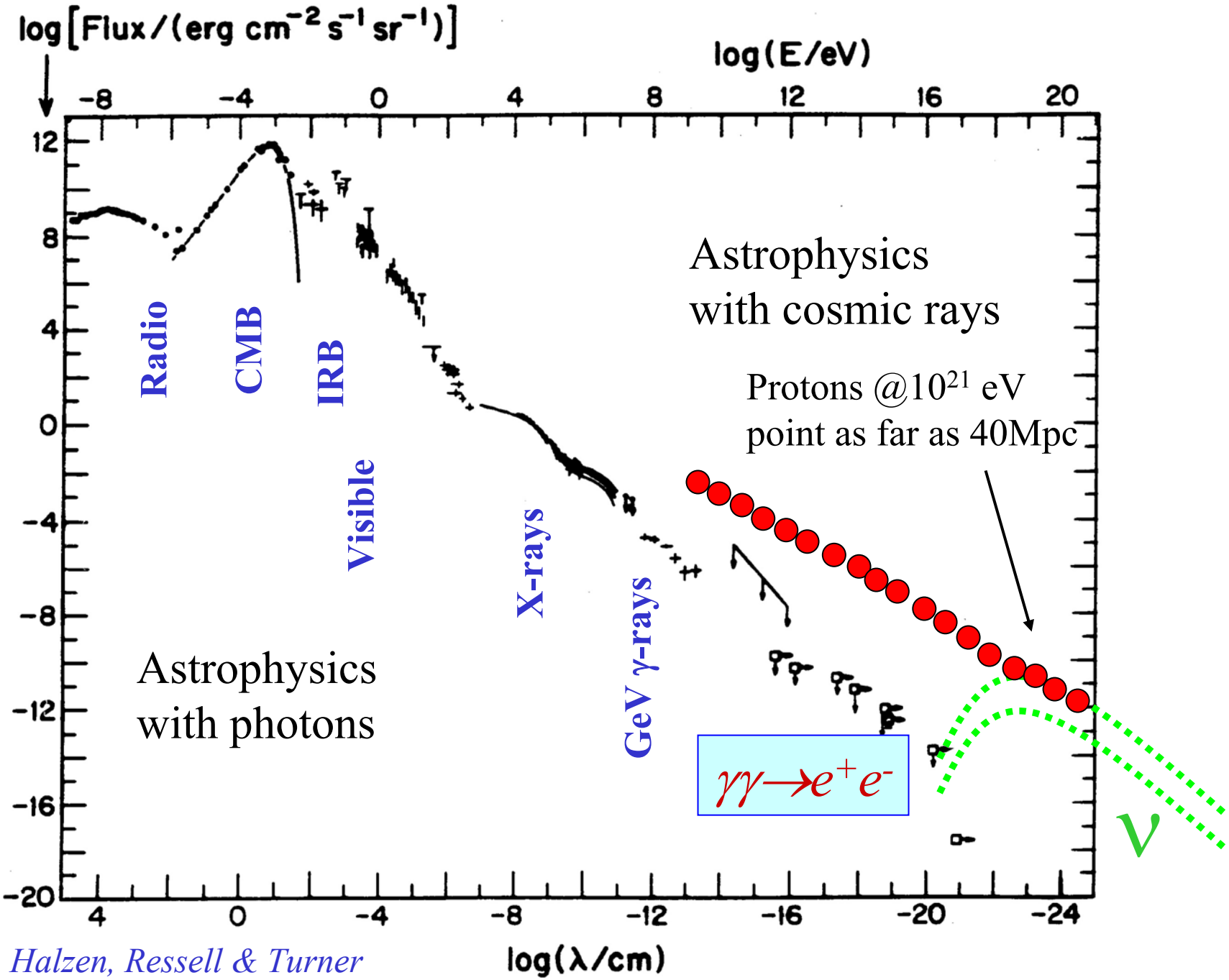
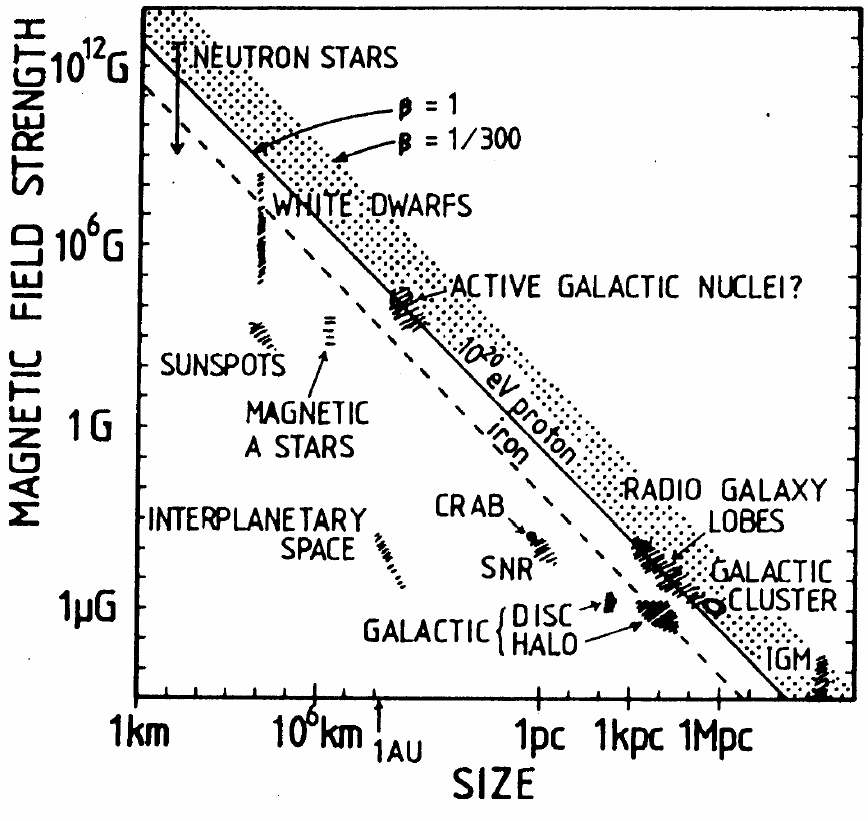
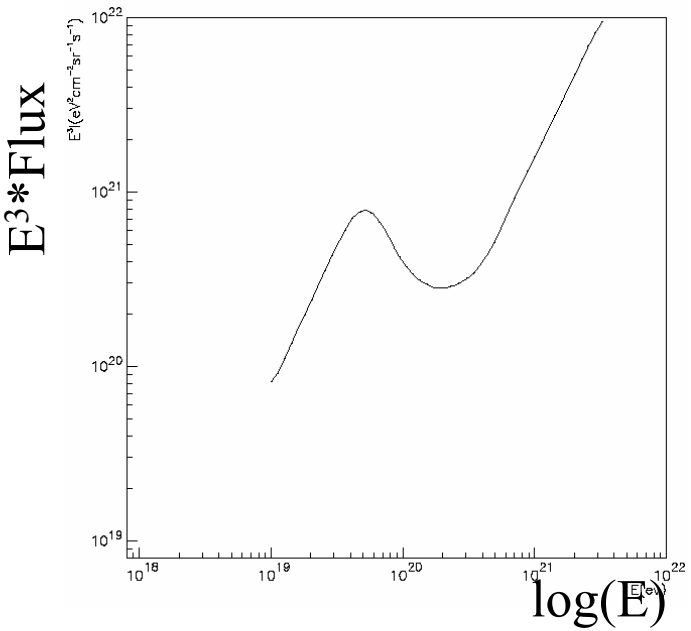
Fermilab
All Experimenter's Meeting
December 15, 2003


log [Flux / (erg cm⁻² s⁻¹ sr⁻¹)]
log (E/eV)
-8
-4
0
4
8
12
16
20
12
8
4
0
-4
-8
-12
-16
-20
Radio
CMB
IRB
Visible
X-rays
GeV γ-rays
Astrophysics
with cosmic rays
Protons @10^21 eV
point as far as 40Mpc
Astrophysics
with photons
γγ→e⁺e⁻
ν
4
0
-4
-8
-12
-16
-20
-24
log (λ/cm)
Halzen, Ressell & Turner

What are the super-GZK sources?

Bottom-up: astrophysical accelerators



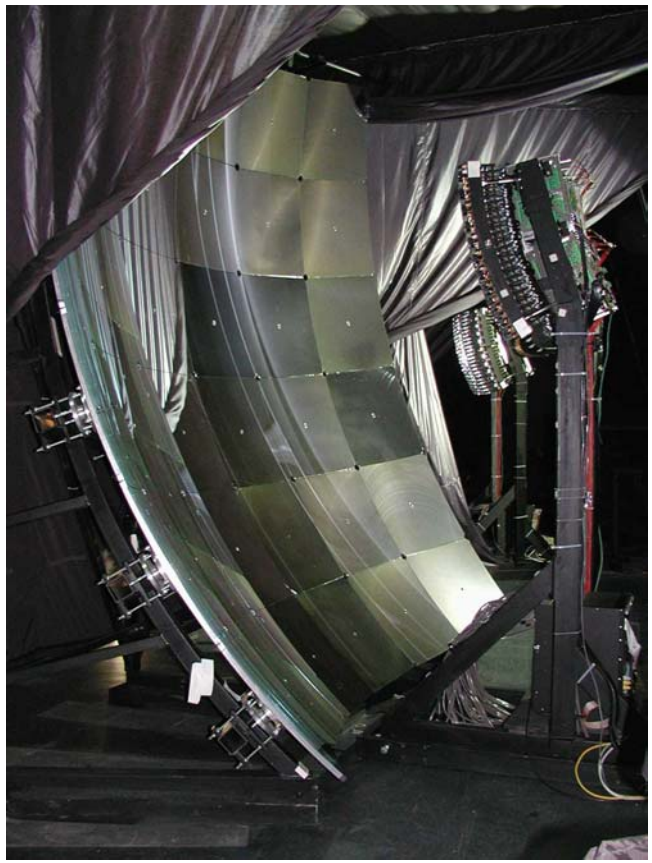


Top-down: decays of topological defects or other supermassive particles. Lots of energetic photons; Spectrum only dips at the GZK Δ resonance

Methods

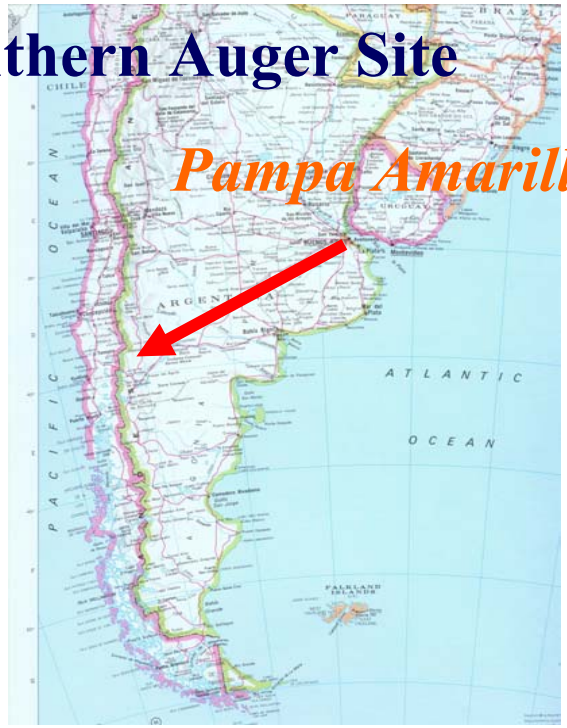
Using the atmosphere as a calorimeter, measure cosmic ray shower **energy, direction, particle ID** using simultaneously:

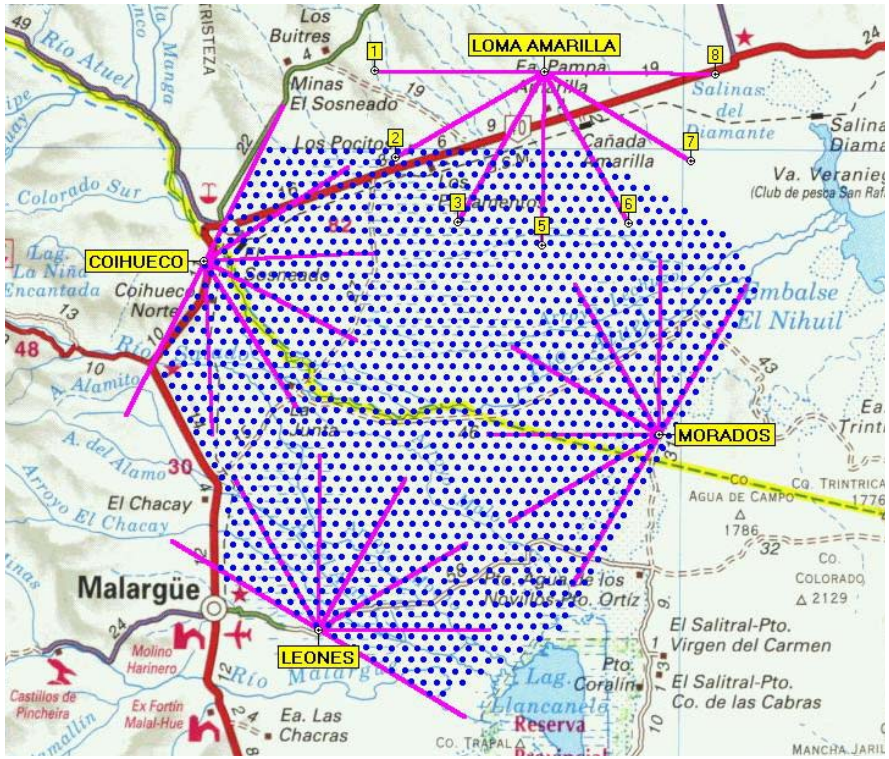
Transverse info from ground array meas.



Longitudinal info from fluorescence meas.

The Pierre Auger Southern Observatory in Malargue, Argentina

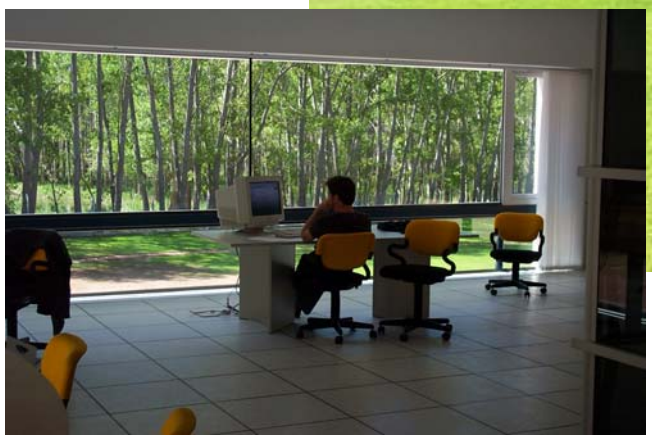




1.5km altitude,
clear dry nights for good viewing

- 1600 surface detectors with 1.5km spacing, covering 3000km^2. (30x AGASA)
- 24 Fluorescence telescopes in 4 buildings. (2x HiRes2)

The Auger Office Building



Data acquisition center

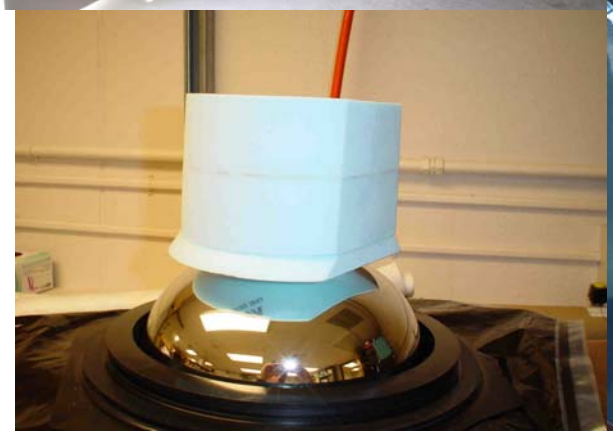
Observatory Staff

Auger SD construction

Resin

Rotomolding

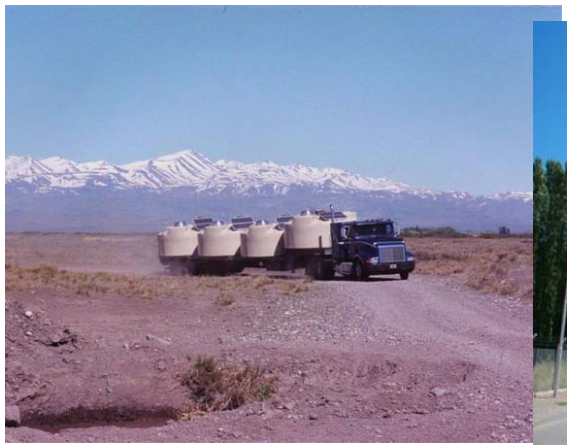
Testing Tyvek liner



Ready for deployment!

9” Photonis PMTs rest on clear plastic windows

Deployment

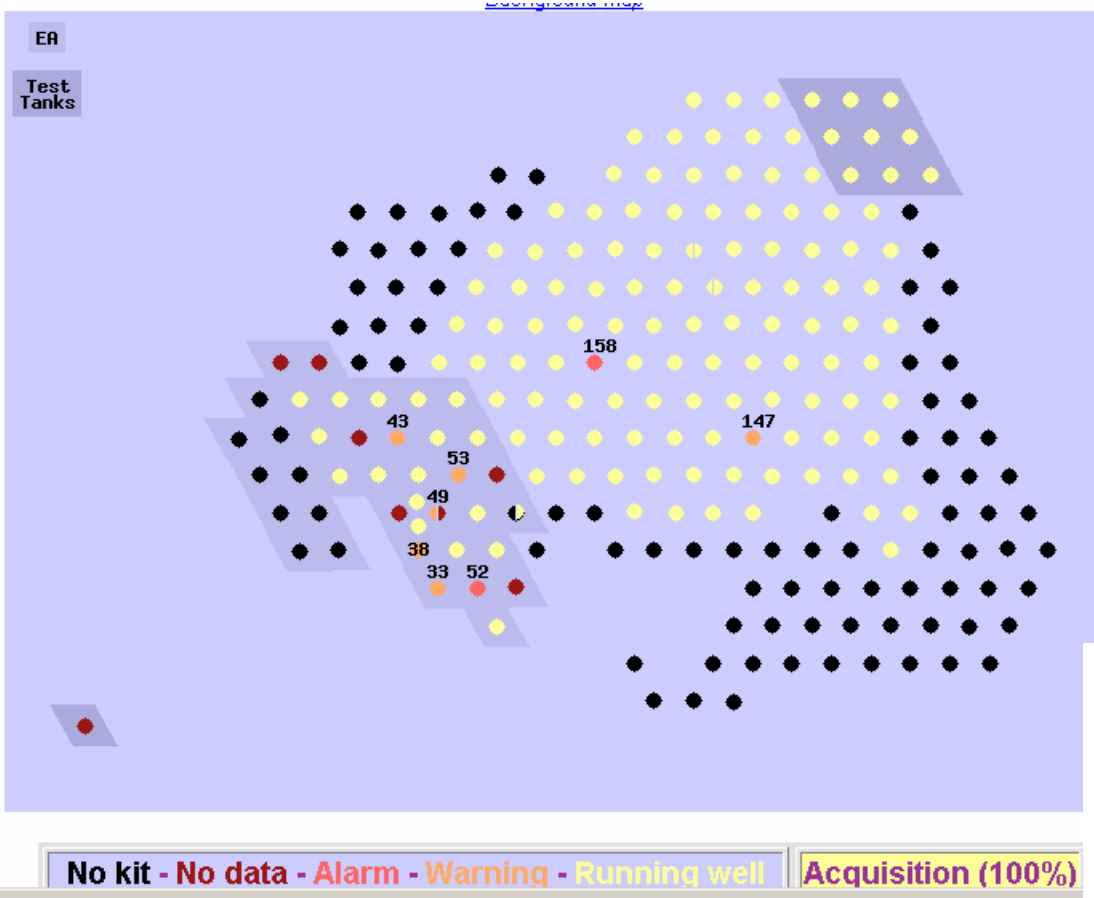


Rate = 3 tanks/day

SD Electronics Deployment

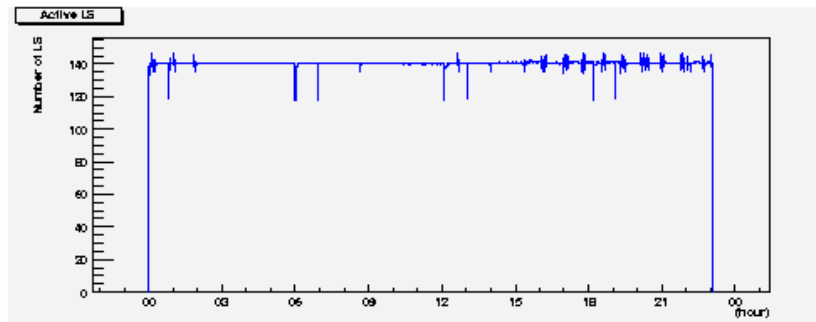
- Installation/Testing/Calibration ~1-2 hours/detector → 6/day

Status of the SD Array

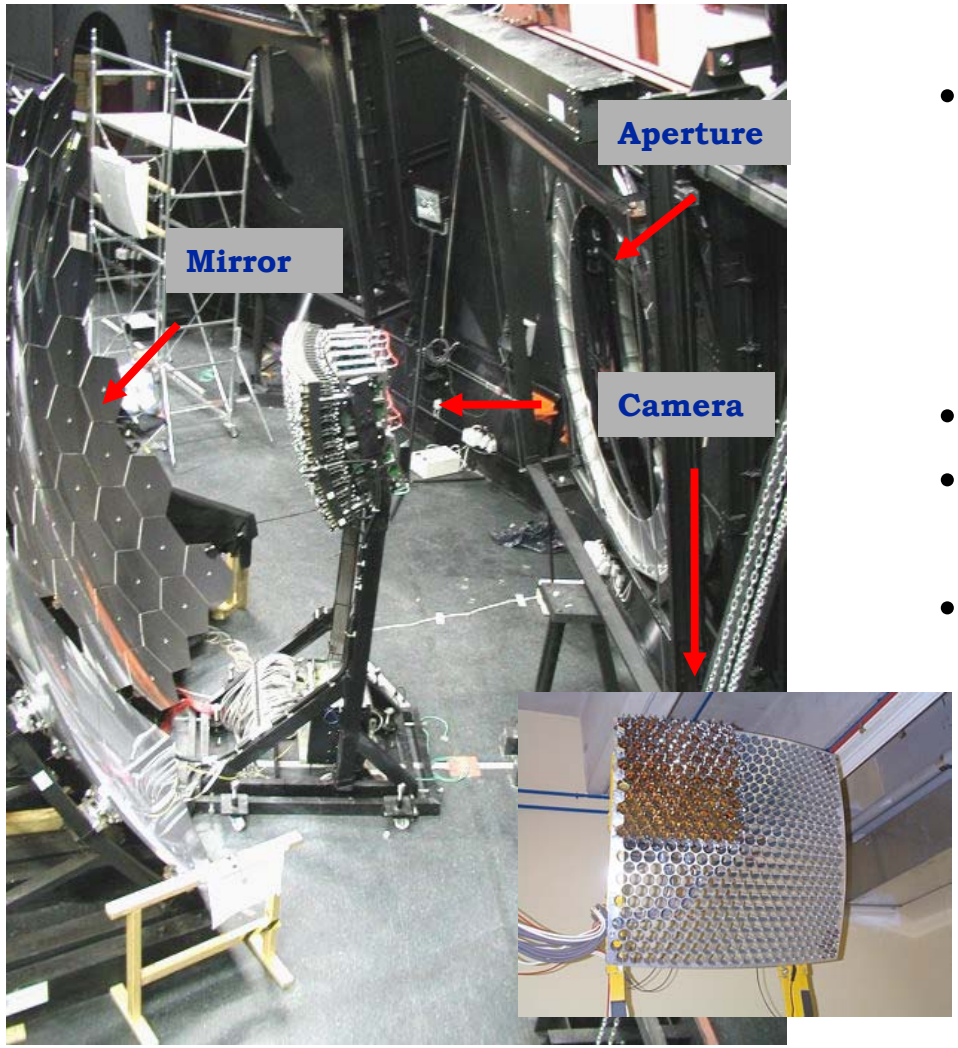


More than 200 tanks deployed,

142 with electronics and in DAQ



The Auger Fluorescence Detectors(FD)

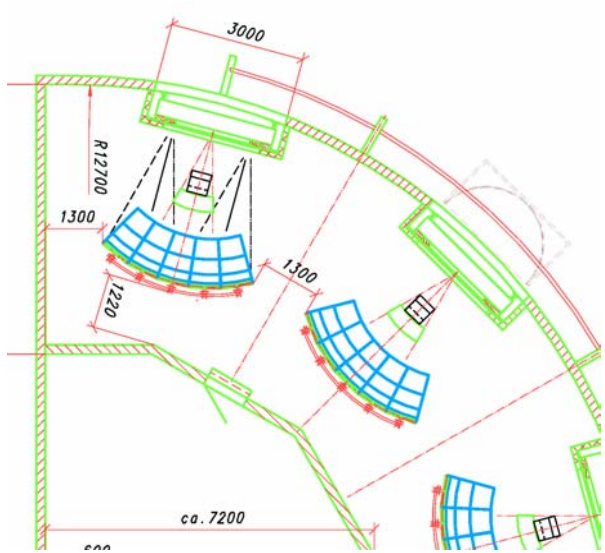


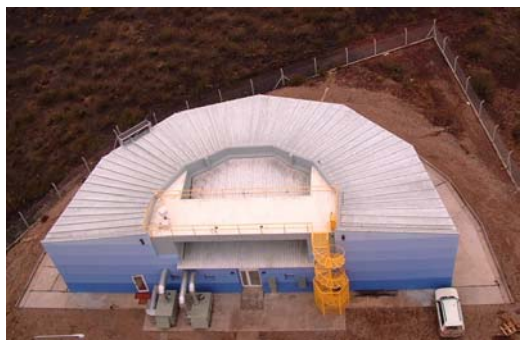
- **Measure N_2 fluorescence** from the EM portion of the shower which carries 90% of the shower energy

- 3.4m diameter mirror,
- 440 pixel camera (PMTs)

- Field of view of each telescope:
  - 30 deg by 30 deg by ~30km

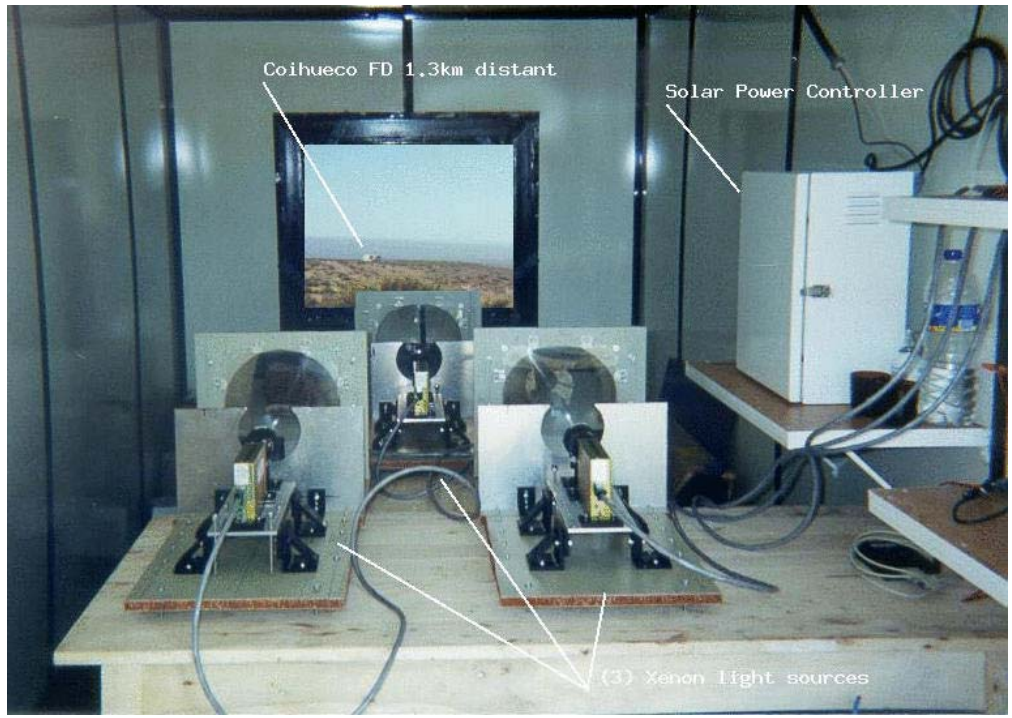
Auger FD buildings





- 24 telescopes placed in 4 buildings around the perimeter of the SD array. (2x HiRes2)
- **Current Status**
  - 6 telescopes (In 2 buildings) already deployed and under remote control. More coming soon.
  - Building #3 (Morados) under construction

Atmospheric Monitoring



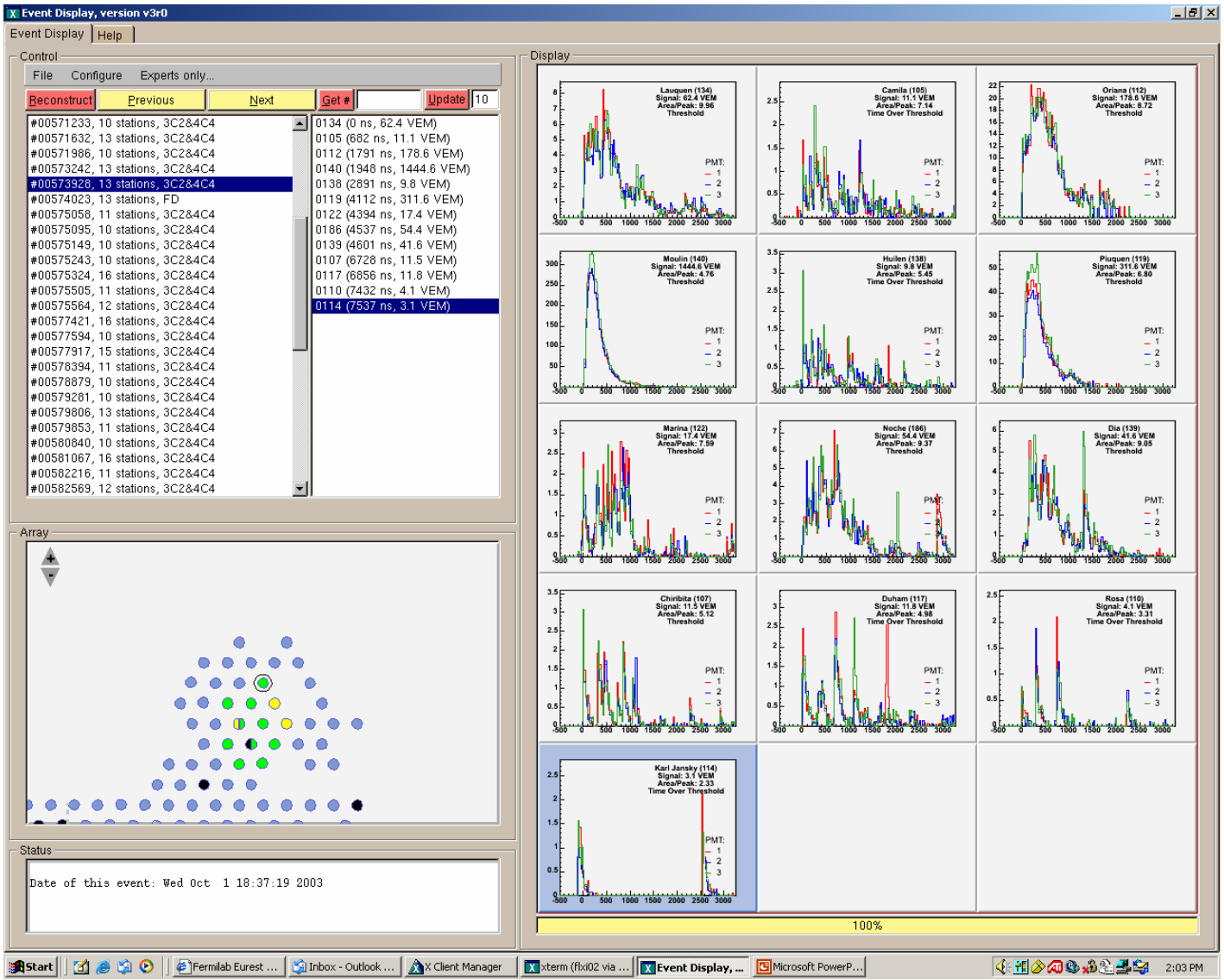
- LIDAR measures atmospheric attenuation via backscattering
- Xe flashlamps measure $1/\sigma * d\sigma/d\Omega$ for side-scattered Cherenkov light

Atmospheric Monitoring (continued)

The Central Laser Facility measures optical depth, FD trigger efficiency, FD-FD timing, FD-SD timing

Radiosonde measures T, P

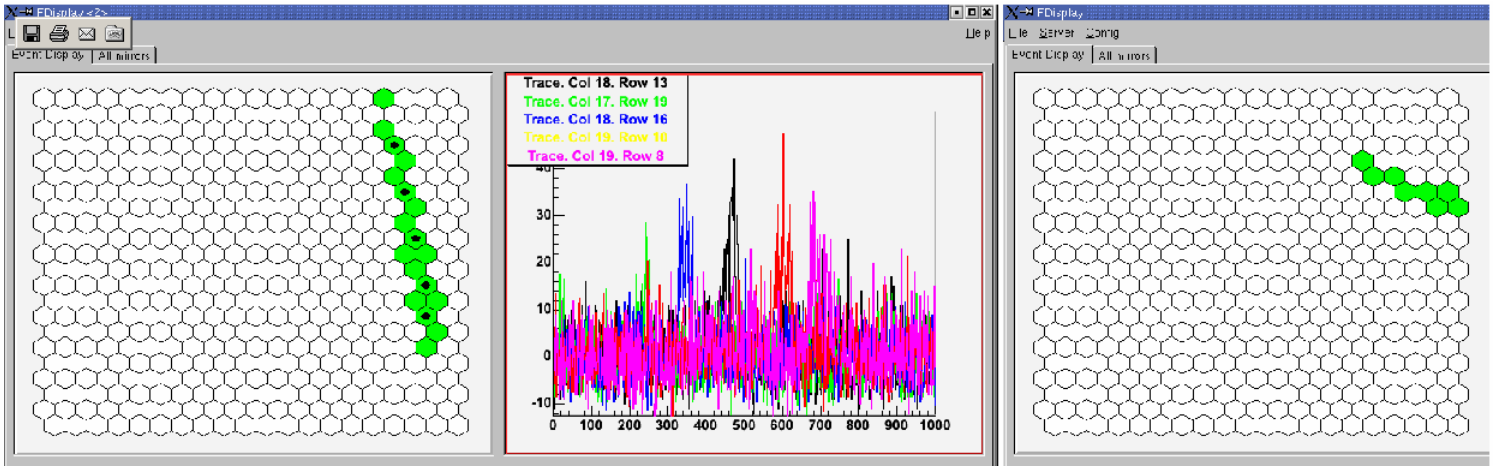
A Near-Vertical Shower ~$10^{19.5}$eV

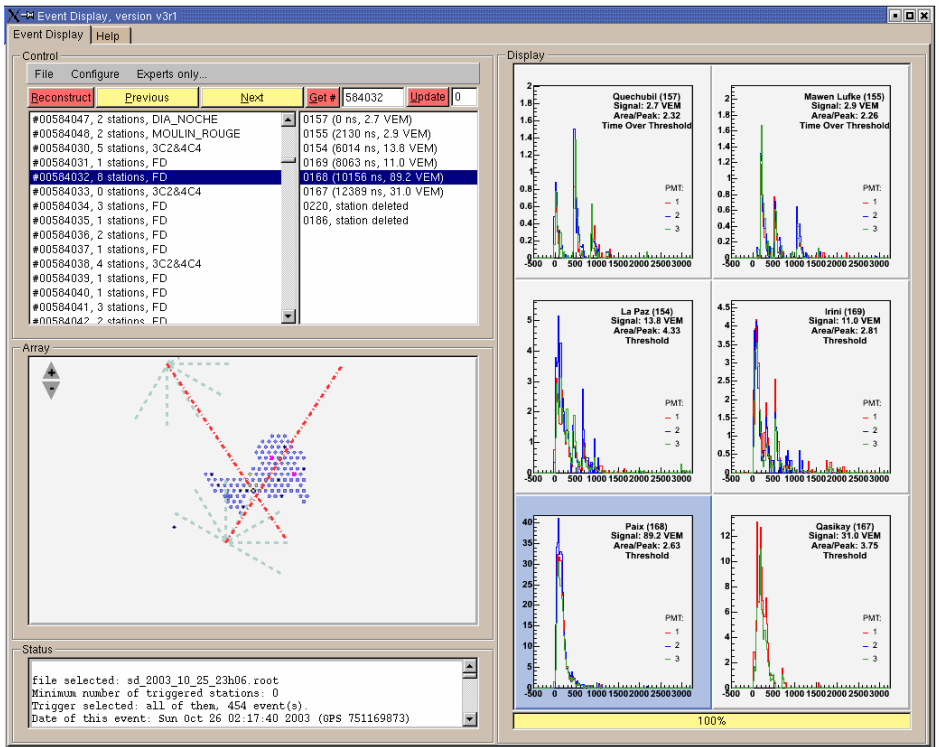


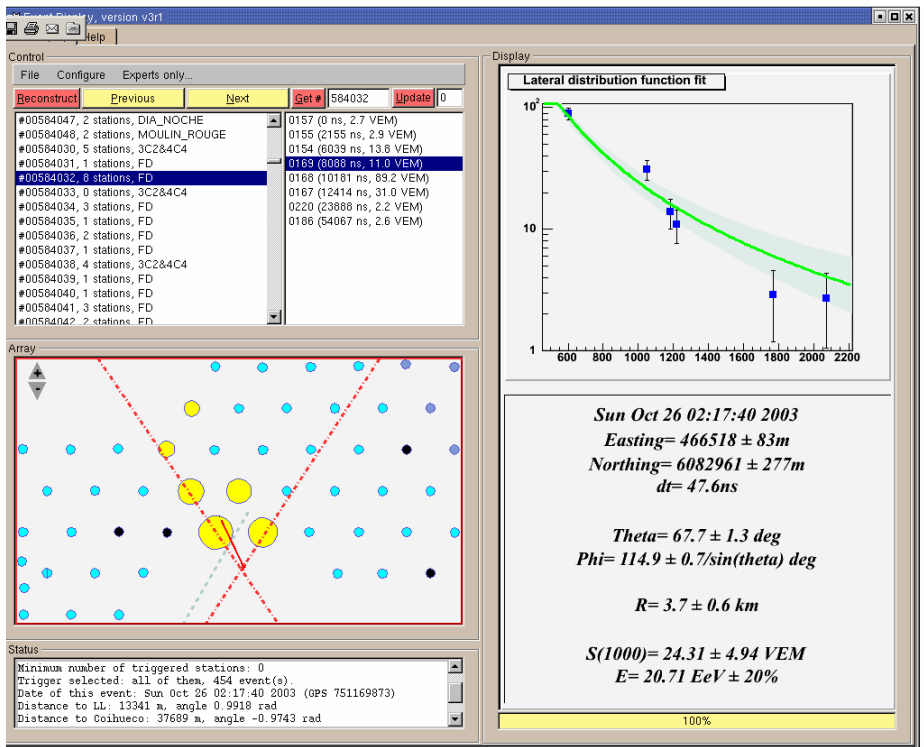
Big EM signals near the core

Intermittent μ signals visible at larger distances

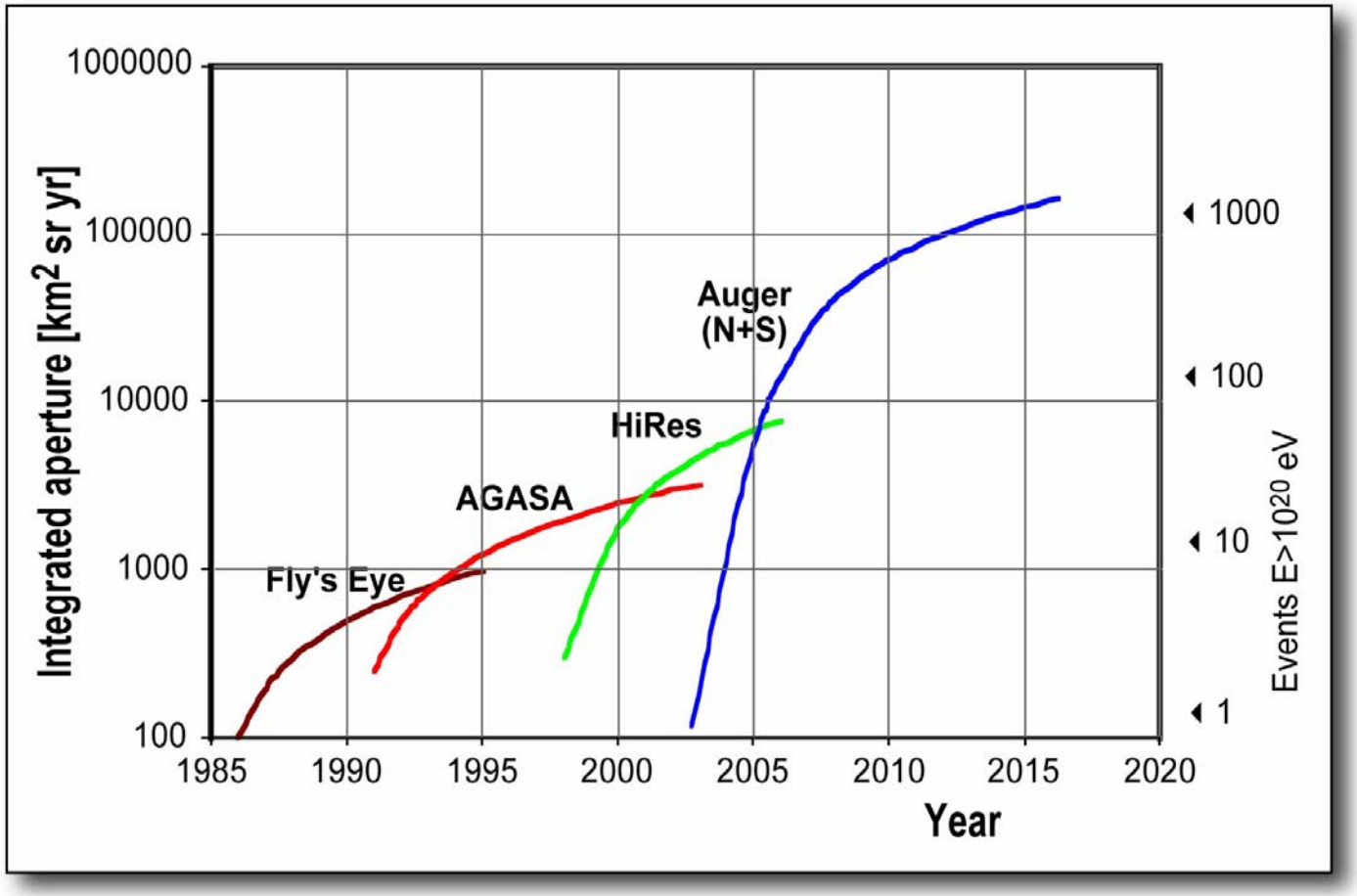
A Hybrid Stereo Event







The Future


1000000
100000
10000
1000
100
Integrated aperture [km² sr yr]
1985
1990
1995
2000
2005
2010
2015
2020
Year
Auger
(N+S)
HiRes
AGASA
Fly's Eye
1000
100
10
1
Events E>10²⁰ eV